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Evaluating the Factors Controlling the Hydrochemistry of Gaza Coastal Aquifer Using Hydrochemical and Multivariate Statistical Analysis

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Abstract : Groundwater in Gaza strip is increasingly being exposed to anthropic and natural factors that seriously impacted the groundwater quality. Physiochemical data of groundwater can offer important information on changes in groundwater quality that can be useful in improving water management tactics. An integrative hydrochemical and statistical techniques (Hierarchical cluster analysis (HCA) and factor analysis (FA)) have been applied on the existence ten physiochemical data of 84 samples collected in (2000/2001) using STATA, AquaChem, and Surfer softwares to: 1) Provide valuable insight into the salinization sources and the hydrochemical processes controlling the chemistry of groundwater. 2) Differentiate the influence of natural processes and man-made activities. The recorded large diversity in water facies with dominance Na-Cl type that reveals a highly saline aquifer impacted by multiple complex hydrochemical processes. Based on WHO standards, only (15.5%) of the wells were suitable for drinking. HCA yielded three clusters. Cluster 1 is the highest in salinity, mainly due to the impact of Eocene saline water invasion mixed with human inputs. Cluster 2 is the lowest in salinity also due to Eocene saline water invasion but mixed with recent rainfall recharge and limited carbonate dissolution and nitrate pollution. Cluster 3 is similar in salinity to Cluster 2, but with a high diversity of facies due to the impact of many sources of salinity as sea water invasion, carbonate dissolution and human inputs. Factor analysis yielded two factors accounting for 88% of the total variance. Factor 1 (59%) is a salinization factor demonstrating the mixing contribution of natural saline water with human inputs. Factor 2 measure the hardness and pollution which explained 29% of the total variance. The negative relationship between the NO3- and pH may reveal a denitrification process in a heavy polluted aquifer recharged by a limited oxygenated rainfall. Multivariate statistical analysis combined with hydrochemical analysis indicate that the main factors controlling groundwater chemistry were Eocene saline invasion, seawater invasion, sewage invasion and rainfall recharge and the main hydrochemical processes were base ion and reverse ion exchange processes with clay minerals (water rock interactions), nitrification, carbonate dissolution and a limited denitrification process.

Keywords : dendrogram and cluster analysis, water facies, Eocene saline invasion and sea water invasion, nitrification and denitrification
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